Google Scholar versus Google Scholar: Among Publish or Perish, Scholarometer, and My Citations, Which Citation Count Tool Is Telling Which Truth?

Ulrich "Tibaut" Houzanme

School of Library and Information Science, Indiana University Bloomington

Three tools that use Google Scholar (GS) as a data source were used to identify citations from 30 of the most influential information scientists (15 from the U.S. and 15 from the UK). Scholarometer is the best tool to recommend overall. Though My Citations ranked second overall, it is the best tool when the data are available. Publish or Perish was clearly the least effective, with numerous author name disambiguation and discipline categorization problems.

Introduction

Citation or reputation computing relies not only on formulas and sources of the data, but also on the tools used to harness such data. A recent addition to commercial citation sources such as Web of Science (WoS) and Scopus, Google Scholar (GS) has continued to improve its coverage and effectiveness. As its reputation has increased, it is more frequently used, not just to complement WoS and Scopus, but also as a viable alternative. Its identified advantages over WoS and Scopus (e.g., languages, breadth of coverage, and far more topics and sources of publications) and its free availability on the Internet make it an attractive source for citation harvesting (De Sutter & Van Den Oord, 2012). Applications are built to harvest GS data and present them

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with some sort of computing, sophisticated metrics, and, of course, different features and interfaces. With regard to this, the three most prominent applications that use GS as a data source are Publish or Perish (PoP), Scholarometer, and Google’s own My Citations service. For all three, GS is the only source of their citations data.

PoP, as one of the very first tools to support citation count using GS data, has been around since 2007 (Harzing, 2010). It is a downloadable application that works on the Microsoft Windows platform. Once installed, the user can query GS and obtain total citations, lists of publications, h-indices, and other measurements. Specifically, it provides author, journal, general citation, and impact measures along with a multi-query center. Seven main subdivisions of scientific fields are available for selection to reflect the field of inquiry. The software manufacturer notes, however, that subject areas selection is not functioning, due to an upgrade of GS, as Tarma Software (2012) reported:

> In May 2012 GS redesigned its interface and integrated the advanced search page in its general search page. In doing so it removed the option to select specific subject areas. As a result subject area filtering is now no longer possible, neither in GS, nor in Publish or Perish. (“Subject area selection no longer functional,” 2012, June 29)

The major consequence of this is the fact that no discipline-specific search is available, and all fields’ search is included, which will amplify and skew the result. The hurdles then, using PoP, are time consumption and disambiguation issues inherited from GS data, issues that have not been fixed by the software.

Scholarometer (www.scholarometer.indiana.edu) “provides a service to scholars by computing citation-based impact measures” (Hoang et al., 2010) that use a crowdsourcing approach, whereby researchers can contribute to building an emergent semantic network that allows the study of interdisciplinary annotations and trends. Scholarometer is a browser add-on for Google Chrome and Firefox that offers a wide range of citation analysis computing in categorized disciplines.

GS’s My Citations (www.scholar.google.com/citations), also called GS Author Citation Tracker, or GSACT, has been evaluated by Jacsó (2012), who found that it provided too little improvement too late over GS. Authors sign up with a Google account and, once their e-mail account is verified, they can manage their publications lists by accepting or rejecting works the system suggests that they have published. The author has the option to make the profile public. This leads to availability of citations and other measures (h-index, i-index, etc.); this approach depends directly on the researcher’s willingness to share. When publications and citations are made public and linked to researchers' profiles, other members of the scientific community can examine and dispute any misplaced publication. This could lead to more transparency and sustained honesty. The author is also responsible for the many tasks required at the data cleansing stage of citation collections, solving many verification and disambiguation issues debated at length by Smalheiser and Torvik (2009).

Perhaps worthy of mention is the Research Impact Evaluation Tool, or ResEval (Imran et. al., 2009), which was not accessible when this analysis was conducted, and thus was excluded (http://project.liquidpub.org/reseval/).

Overall, Meho and Yang (2007) have identified a strong link between the data source (WoS, GS, Scopus) and the citation count. In this study, the data source is the same (GS), but the tools are different. One would expect that a same author would have the same citation count, regardless of the application tool. Do these three tools actually produce equivalent results? The main question investigated here, however, is which GS citation analysis application is the best.

Literature Review

The literature review focuses on two aspects: The sources of citation indexing and the tools' basic requirements in terms of author name disambiguation.

Sources of Citation Index

The prominent research citation sources (WoS, Scopus, GS) have been used either in confirmation of, comparison with, or as complements to one another (Jacsó, 2005a; Meho & Yang, 2006, 2007; Bar-Ilan, 2008, 2010). Meho and Yang (2007) uncovered a significant overlap among the three main data sources (58.2% overlap between Scopus and WoS and only 30.8% overlap between the union of the previous two and GS), which shows that 48.3% of the literature indexed in GS is available neither in WoS nor in Scopus.

GS has been available since 2004, WoS, as an online searchable database, since 2002, and Scopus since 2004. Over the past decade, many researchers have compared them. Not only has the content of GS been found to be deeper and broader, it has also been found to be "scholarly" (of research quality), in comparison to commercial databases available through libraries (Howland et. al., 2009; Kousha & Thelwall, 2008). However, as it came about only in 2009, Microsoft Academic Search (http://academic.research.microsoft.com) has probably not had enough time for similar review, and little is known of its comparative depth and breadth of coverage. Initial reports, however, suggest that its interface is more appealing and its results are cleaner. Nevertheless, Microsoft Academic Search was not included in this analysis because it does not use GS as a data source.

This research focuses solely on GS, based on evidence in the literature of its broad coverage (William, 2008; Bornmann et al., 2009; De Sutter & Van Den Oord, 2012). Some researchers report that GS lacks accuracy, even as they praise its comprehensiveness (Garcia-Perez, 2010; Beel & Gipp, 2010). In any case, GS is subscription-free (unlike WoS and Scopus) and is widely available to researchers on the Web. In addition, it is viewed as an indispensible tool in terms of compiling comprehensive, complete, and fair citation counts, as a complement to WoS and Scopus (Meho & Yang, 2007; Bar-Ilan, 2008; Garcia-Perez, 2010; De Sutter & Van Den Oord, 2012). There remains the question of whether GS should be used alone or alongside other data sources.

Author Name Disambiguation and the Tools

For the tools to be considered of high quality, they must address the major issues related to literature attribution to the right authors. Smalheiser and Torvik (2009) have identified in their landmark study four challenges with author name disambiguation: 1) a single author publishing under different names, including orthographic variants and misspellings, name change over time for social, religious, gender, or other reasons, 2) different authors carrying the same name, 3) lack of metadata such as nationality, birth date, and so on, to help disambiguate authors, 4) multi-authors, multi-disciplinary, and multi-institutional publications / collaborations make it hard to identify all authors or determine the right discipline of the publication, or the most deserving institution of the collaboration. The focus of this article will be on discovering the tools that directly or indirectly incorporate these challenges in their design or approach for accurate publications and citations counts, which, in turn, have an impact on the ranking of the tools.

Research Question

In light of the tools available and the context of this inquiry, what makes the difference when all tools share the same GS data source? In this particular case, it would not be unreasonable to expect the same result for citation count when the tools share the same data. However, there is a difference between the results, which leads us to the following questions:

- Is the difference attributable to limitations in the data available to the applications?
- Do the tools disambiguate authors effectively?
- Do differences in tool features / approaches influence the results?

These questions will be addressed using researchers in library and information science (LIS) as the test case. The results are therefore not generalizable to all disciplines and cannot help answer questions such as what causes the difference for every discipline or even which factors explain the difference within the same discipline. Previous research has also focused on comparisons within a single discipline because of the complexity of citation data and the available data sources.

Though the researcher will not undertake extensive disambiguation and data cleansing, he or she will use a relatively significant statistical sample that provides a meaningful conclusion. The underlying intention is to assess how well the tools perform with very little human intervention. Similar studies can be replicated in other disciplines to help compare the findings across fields.

Methodology

Previous studies that compared results of citation analysis have focused on both the data sources and the tools used, their features, interfaces, and error rates. All those variables had an impact on the conclusions (Jacsó, 2005b, 2005c; Meho & Yang, 2006, 2007; Bar-Ilan, 2008; Howland et al., 2009; Bornmann et al., 2009; Bar-Ilan, 2010). Of special interest are studies and methods that focused on a single source or the citation index as a secondary data source (Davis & Shaw, 2011).

As a preliminary attempt to compare GS applications, this study focused on LIS researchers. The objective is to explore the comparability of the applications, not to uncover general trends in all fields of study. The three applications analyzed will be ranked from most to least accurate, as they report the citation counts for the 30 most influential scholars in LIS.

Study Sample and Its Significance

A purposive sampling method has been used, and one that spans two continents and presents a longitudinal case study (Choemprayon & Wildemuth, 2009): In this case, the study examines citations of the work of five of the most influential LIS researchers in the United States and five from the United Kingdom. In using these scholars, who were identified in previous studies as among the most prolific, the expectation is to provide enough data that could potentially be indexed by GS and thus to provide enough data to the applications. The somewhat limited sample in this pilot study does not carry enough weight to draw conclusions about the impact of these scholars' research, but it will help elucidate the general characteristics of the tools that could inform more ambitious studies. Using the three GS applications, lifetime citation counts were extracted on September 25, 2012 for Nicholas J. Belkin, Tefko Saracevic, Marcia J. Bates, Christine Borgman, Blaise Cronin, Gary Marchionini, Raya Fidel, Katherine W. McCain, Amanda Spink, Howard D. White, Michael K. Buckland, John M. Budd, Andrew Dillon, Peter Hernon, and Carol C. Kuhlthau (Cronin & Meho, 2006), and for Peter Willett, Stephen Robertson, Mike Thelwall, David Ellis, Nigel Ford, Maurice Line, Tom Wilson, Keith van Rijsbergen, Cyril Cleverdon, Stevan Harnad, Michael Lynch, Brian Vickery, A. E. Cawkell, David Bawden, and Jack Meadows (Oppenheim, 2006).

Results and Discussions

The analysis focused on the evaluation of the tools' conformance with literature recommendations, on the practical side of the tools' evaluation that includes the availability, accuracy, and intrinsic differences or similarities within the tools and effort level demanded by the tool, as well as on an overall consideration of all these factors.

Tools' Conformance Levels with Literature Recommendations

My Citations includes most of the disambiguation challenges identified by Smalheiser & Torvik (2009), such as name variations suggestion, different names for the same author, identifying metadata, collaboration, and discipline weight. This could be explained by the fact that authors' self-identification, e-mail verification through institutional domain name, and assumed correction of data on her / his profile take care of most of the issues related to accuracy, except in the case of different identities related to the same author, which has not been solved yet. So, from a purely conceptual or theoretical standpoint, My Citations appears to meet more requirements than Scholarometer or PoP, and in second place is Scholarometer, because it takes care of some of these disambiguation issues, such as name variation suggestion and discipline categorization; it also provides some level of collaboration data. The third position obtained by PoP, in theory, reflects the lack of efficiency with data accuracy. Whether these observations are confirmed in practice will depend on the assessment of data availability, accuracy, and the level of effort invested in the process. So, with practical experimentation in terms of citation harnessing, the performance of each of the three tools has been evaluated on the three grounds enunciated, and the following results, observations, and analysis ensued.

Availability of Citation Data

Top 15 U.S. Information Scientists (Cronin & Meho, 2006)	PoP Ver. 3.7 # of Papers	PoP Ver. 3.8 # of Citations	GS My Citation # of Papers	GS My Citation # of Citations	Scholarometer # of Papers	Scholarometer # of Citations
Nicholas J. Belkin	186	8546			155	7705
Tefko Saracevic	236	8471	184	8260	147	7813
Marcia J. Bates	158	5692			236	11454
Christine Borgman	361	6114			260	5762
Blaise Cronin	355	4788			229	4499
Gary Marchionini	320	8079			252	7920
Raya Fidel	112	2627			76	2514
Katherine W. McCain	87	3109			71	3060
Amanda Spink	340	10002			264	9802
Howard D. White	991	30319	99	3718	108	4564
Michael K. Buckland	207	3660			81	1831
John M. Budd	485	7015			96	1401
Andrew Dillon	837	16380			201	5172
Peter Hernon	512	3654			171	2989
Carol C. Kuhlthau	108	5490			34	2212
Top 15 U.K. Information Scientists (Oppenheim, 2006)	**PoP Ver. 3.7 # of Papers**	**PoP Ver. 3.8 # of Citations**	**GS My Citation # of Papers**	**GS My Citation # of Citations**	**Scholarometer # of Papers**	**Scholarometer # of Citations**
Peter Willett	1000	31312	506	18031	224	17125
Stephen Robertson	1000	49338	39	130	112	3234
Mike Thelwall	287	6391	284	6487	283	6425
David Ellis	1000	108943			91	6967
Nigel Ford	298	8570	136	3272	116	3146
Maurice Line	500	2774			13	123
Tom Wilson	1000	37082			171	1762
Keith van Rijsbergen	52	239			22	74
Cyril Cleverdon	76	2074			11	637
Stevan Harnad	569	12555	482	12297	204	10259
Michael Lynch	1000	104575			185	33958
Brian Vickery	282	5938			46	605
A.E. Cawkell	156	501			108	363
David Bawden	436	3651			237	2887
Jack Meadows	259	2670			130	1441

Figure 1. Results of citation count extraction from PoP, GS My Citations, and Scholarometer

As seen in Figure 1, Scholarometer and PoP have citation data available for each of the 30 information scientists. My Citations lacks citation reports on about 75% of the researchers. One possible explanation is that these established scholars have not signed up with My Citations yet. They may not perceive great personal benefits, although their participation would help the following generations benefit from access to their publications and profile on My Citations. PoP’s limitation of 1,000 publications does not prove usable for prolific researchers. And as the number of publications is limited, so are the total citations obtained. Considering the fact that some data, even if further investigation is required, is better than no data at all, then with regard to citation data availability, Scholarometer is most recommendable, with PoP as a distant second choice. My Citations has some caching up to do.

Accuracy of Available Citation Data

As was indicated above, the accuracy of the citation data is closely linked to the disambiguation challenges addressed with each tool. Selecting the appropriate discipline with PoP produced indifferent results, because it did not increase or decrease the total citations counts obtained when all disciplines were selected.

Also, when the most prolific information scientists are shown to have published between 300 and 600 titles, PoP’s over 600 and potentially more than 1,000 publications show a crucial lack of disambiguation. For that reason, and for those addressed in the data availability analysis, PoP’s citation count is not accurate, particularly for the most productive scholars, who may have authored over 1,000 publications.

In addition, some total citation counts (Figure 1), such as David Ellis’s and Michael Lynch’s, are way beyond the norm for most cited LIS scholars, which calls for caution. Also, the data flagged in the first shade of gray (Figure 1) shows a limitation of PoP data to 1,000 publications. As a consequence, both PoP’s publication and citation count data appear inflated.

Scholarometer’s citation counts (Figure 1) are trailing below almost every PoP count. Based on the observations above, Scholarometer has a more trustworthy status because of its output compared to that of PoP.

The somewhat limited output of publications and citations counts with My Citations, in comparison with Scholarometer’s and PoP’s data, could be explained by the disambiguation built into the application and the discipline-specific search it supports.

Only in one case (Peter Willett) did My Citation retrieve more data than Scholarometer, but the difference of almost the double of the total number of publications, coupled with about the same number of total citations, is pretty apocryphal and deserves further investigations outside the scope of this research.

Intrinsic Similarities or Differences between the Tools Results

This comparison of intrinsic differences would be useful for tool selection, whereby a backup or comparison tool would provide meaningful and different information not covered by the second tool or other tools retained or domesticated (Schroeder & Dimitrina, 2009). The ultimate benefit for such an approach would be to compare and contrast so as to be able to investigate the stark differences and why they exist.

Table 1. Spearman's correlation coefficient between citation counts from My Citations, PoP, and Scholarometer

Spearman's rank correlation coefficient	**# of Citations**		
	GS My Citations	PoP Ver. 3.7	Scholarometer
GS My Citations	1	-0.085	0.942
PoP	-0.085	1	-0.257
Scholarometer	0.942	-0.257	1

The citation count results of all the tools, where there is an entry or data available for each of the three tools, show that Google Scholar and My Citations have a strong correlation (0.94). This means that using these two tools together would not yield much difference when the data are available and a choice of either one without the other would be acceptable.

However, PoP and Scholarometer's highly negative correlation (-0.257) suggest that the tools produce sufficiently different results, which can be used to contrast with one another and might yield enough material for comparison.

The negative contrast of PoP and My Citations (-0.085) also suggests a difference that can be contrasted and compared for accuracy verification. It is not, however, as strong a difference as between PoP's and Scholarometer's results, in a normal circumstance. This observation is impeded by the aforementioned fact that PoP has major flaws that can lead to a considerable waste of time trying to investigate. Because of this, this paper recommends using, for the sake of more meaningful results comparisons, My Citations and Scholarometer at the same time.

Because the tools share GS as a data source, using the two least correlated tools, in a truly acceptable norm, offers an opportunity for challenges and investigations that will likely reveal meaningful results.

Effort Level in the Use of the Tools for Citation Data Harvesting

While the question of how "little effort" should be spent collecting citation data was asked, it is not a full usability question. And though no usability test and survey have been conducted, it is the author's report of personal experience that is the case here. Individual experience could vary with operating systems, terminal access, and software or application. This comment is of an individual nature and needs more investigation with a study along the lines of the specific reasons for the comments. This being said, the author finds the least difficulty with My Citations, as the data are readily available or not available; PoP also seems simple to use once the software is installed. Scholarometer appears simple, though the wait time and the inability to navigate away from the browser do not make for time-efficiency, particularly when one has many scholars' citation data to search. This reporting relates to the author's experiment with the tool, and it is not believed that the observation has a heavy weight. Therefore, further studies focusing on usability are suggested for a more informed conclusion and recommendations.

Overall Theoretical and Practical Evaluation

Combining both theoretical and practical aspects of the tools evaluation, including missing data in My Citations, Scholarometer scores better and is preferable, but its data must still be disambiguated.

When all data are available on all the scholars, My Citations would be preferable because of the disambiguation built into it, though more investigation of the accuracy would be recommended to draw safer conclusions.

Though this paper can recommend the use of Scholarometer, I caution against a blind trust and exhort verification of data accuracy. In cases where the data are available in all three tools, I would give a slight edge to My Citations because of the prior conclusion, though I still would recommend investigating data accuracy, as well as verification of publication and citation integrity.

Overall, because of the complexity of the data, the missing data, and data inflation, it is not easy to declare a de facto winner, though Scholarometer is preferable considering all aspects at the same time. For that matter, circumstances are diverse and the performances can only be appreciated based on the specific circumstance.

Conclusions

To date, no study, before this one, has endeavored to compare the accuracy and completeness of the three GS-based applications investigated. Comparing them to one another is equal to comparing GS to GS, with the differences existing in the application design and behavior.

And to summarize this experiment, by using three different applications for retrieving and counting GS citations, My Citations scores good theoretical points because of the two takes on validation (system and the author her/himself). However, it lacks entries for about 75% of the scholars, which renders its recommendation difficult.

PoP did a good job until Google changed the setting of GS, making PoP's results hard to use without a significant amount of time to disambiguate. Data limitations and, particularly, inflation render it not recommendable at this time.

Scholarometer, with built-in disambiguation features, despite wait time for results that lowers productivity in the case of a massive-scale project, with discipline selection choice, altogether provides more acceptable results with few citation counts over the chart to investigate.

In short, the overall evaluations of the disambiguation features, the accuracy of the data, the availability of citations, and to a lesser degree, the ease of use appear more favorable to Scholarometer.

A combination of Scholarometer's and My Citations' use, when the data are available, will provide enough meaningful contrast for sources of investigation.

These conclusions are not applicable in a context of researchers cheating the citation system (Labbé, 2010). Nevertheless, this experiment can be replicated in other disciplines, and the outcomes used in meta-studies can help determine overall trends and the most reliable tools. As Albion (2012, p. 1) concluded from a study on citation count rates in the field of education, "Valid comparisons depend upon the availability of discipline-specific benchmarks."

Longitudinal studies across disciplines and studies of other open access citation sources (Meho & Sugimoto, 2009), such as Microsoft Academic Search tool, will help further elucidate the value of the available tools. In this era of Web-delivered, language-independent, and no-fee citation data access and study, researchers have access to remarkable sets of tools to continue applying the paradigm Sir Isaac Newton described in the 17th century: build on the shoulders of giants.

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